UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY
2565 PLYMOUTH ROAD
ANN ARBOR, MICHIGAN 48105-2498

OFFICE OF
AIR AND RADIATION

April 23, 2010

Mr. Steve Bollinger
General Motors
Compliance & Certification Group
M/C 483-331-500
3300 General Motors Rd
Milford, MI 48380

Dear Mr. Bollinger:

Thank you for the time and assistance provided by employees of General Motors (GM) during the recent audit of your facility conducted by the U.S. Environmental Protection Agency (EPA) staff members. This letter is a follow-up to that audit.

The contents of this letter and attachments, with the exception of the exhaust emission test results, will be held confidential by the EPA. All written, electronic, and oral information and materials disclosed or provided by GM related to this audit will be treated as confidential as described by Title 40, Parts 2 and 86 of the Code of Federal Regulations regardless of whether it was provided before, during, or after the audit (Please note, test results are always non-CBI).

As we discussed in the phone conference of March 11th, 2010, the purpose of the audit was twofold: first, to determine if the procedures and equipment used by GM for testing heavy-duty on-highway engines are in compliance with EPA regulations, second, to verify that engine family BGMXH06.6590 is in compliance with the exhaust emission regulations of Title 40 Part 86 of the Code of Federal Regulations. The audit team consisted of Cleophas Jackson, Carl Ryan, Jay Smith and Dan Cullen.

As part of the audit, the accuracy of GM's exhaust emission analyzers was determined. GM personnel measured the concentration of EPA-provided gases that are traceable to National Institute of Standards & Technology (NIST) gases. These gases were sampled by the analyzers in test cell D102. For each of the analyzers checked, the analyzers measured the gases within the required 2% tolerance for all ranges. The actual gas concentrations and the GM measured concentrations can be seen in Table 1.

Table 1 - NIST Gas Bottle Concentrations

Constituent (relative concentration)	EPA Concentration	GM Concentration	% Error
NO_x (low)	4.553	4.626	1.601
NO_x (high)	7.869	7.945	0.970
CO (low)	9.795	9.873	0.795
CO (high)	49.107	48.514	1.208
CH_4	4.957	4.911	0.952
C_3H_8 (low)	4.512	4.597	1.883
C_3H_8 (high)	29.319	29.414	0.324
CO_2	0.959	0.944	1.492

During the audit, the EPA observed engine family BGMXH06.6590 undergo paired cold/hot transient testing, steady state testing over the Ramped Modal Cycle (RMC) test, and Not-to-Exceed (NTE) testing at 4 modal points selected by EPA. Two other points were tested that were in the NTE zone, but fell into GM's Restricted Test Zone (RTZ) request and are thus not included in Table 2. We also reviewed the overall heavy duty engine certification process, laboratory calibration and maintenance records, laboratory quality control and quality assurance process, and fuel analysis documentation. A summary of the items audited and our observations are contained in the enclosed audit "checklist." {The checklist has been completed based on information provided by GM after the audit.} No non-conformances were observed during the audit.

Based on the test results provided by GM, and the information on the certification application, deterioration factors and adjustment factors for infrequently regenerating devices were applied and the final adjusted results were determined. These adjusted values are presented in Table 2 and compared to the emission standards of §86.007-11. These results represent the official test results for engine family BGMXH06.6590 and the application for certification must be updated accordingly. In addition, results from NTE testing are presented in Table 2 and compared to the NTE emission standards. In summary, the engine was found to be in compliance with emission standards.

Table 2 - Certification Levels (all values in g/BHP-hr)

Family - BGMXH06.6590	**NMHC**	**NO_x**	**CO**	**PM**	**CO_2**	**Result**
Emission Standards/FEL	**0.14**	**0.46**	**15.5**	**0.01**	--	--
Adjusted Transient Results	0.01	0.32	0.3	0.00	617	Pass
Adjusted RMC Results	0.00	0.24	0.0	0.00	568	Pass
NTE Emission Standards	**0.21**	**0.69**	**19.4**	--	--	--
NTE Peak Results – Mode 1	0.01	0.29	0.1	n.m.	556	Pass
NTE Peak Results – Mode 2	0.01	0.36	0.1	n.m.	548	Pass
NTE Peak Results – Mode 3	0.01	0.31	0.1	n.m.	562	Pass
NTE Peak Results – Mode 4	0.01	0.35	0.1	n.m.	573	Pass

"n.m." = not measured

Due to the test cell setup on the date of this test, it was impractical to take PM samples during the NTE testing.

In conclusion, the EPA has found that GM engine family BGMXH06.6590 is in compliance with emission standards and we have forwarded this finding to GM's certification representative. Furthermore, we believe that the GM HD certification process and facility are compliant with the regulations. At this point, the audit process is complete and you should work with your certification representative to finalize the certification process.

If you have questions about this letter, please contact Jay Smith of my staff at (734) 214-4302 or by email at smith.jay@epa.gov.

Sincerely,

Cleophas Jackson, Jr.
Assistant Director
Compliance and Innovative Strategies Division

Laboratory Inspection Checklist

Lab: GM Powertrain-Pontiac	**Inspected by:** D.Cullen, C. Jackson, C. Ryan, J. Smith	**Date:**	March 24-25, 2010	
Manufacturers Reps (Primary Contacts):	Rob Sutschek	**Type of tests performed:**	Cold/Hot FTP (HDT4, 5, 6)	
See document: Audit Participant List xls for full list	Dave Pitschel		RMC (RMC5)	
	Bill Watson		NTE Evaluation	
	Randy Harvey			

		Information & Comments	Regulations	Audit Observations	Manufacturer's Follow-up Action
1	**Laboratory Equipment Description**				
1.1	Dynamometer - make & model	Horiba QDI31.3-2FL	§1065.110	Information supplied in form of site inventory (Document 1.1)	
1.2	Exhaust Analyzers make, model	AVL, Horiba, Rosemount (see site inventory, Item ID: 017223)	§1065 subpart C	Information supplied in form of site inventory (Document 1.1)	
1.3	Gas Divider make & model	AVL GNU 63-100, SN 5179		Information supplied in form of site inventory (Document 1.1)	
1.4	Sample collection				
	Batch sampling containers	Material, number	§1065.170(b)	Kynar (refer to 3/12/10 email from R. Sutschek, Doc 1.4); sample and background bags used for each test	
	Heated sample lines		§1065.145(c)	Yes, Atmo-Seal® brand lines	
	Sample line path	Length kept to a minimum? 90° Bends avoided? Good engineering judgement excercised?	§1065.145(c)	Requirement met. Reference test cell photographs	
1.5	CVS Considerations				
	Make & model	AVL CVS60; Seperate gas and diesel		Information supplied in form of site inventory (Document 1.1) & Document 1.6	
	Dilution ratio			Reference test report, Example, HDT6, page 7: QA dilution ratio = 6.19	
	Pressure control	Static pressure within ±1.2 kPa at initial dilution point?	§1065.140(c)(2)	Described in summary of dilute sampling system (Document 1.5.pdf)	
	Temperature control	Dilution air temp?	§1065.140(a)	Reference test report, Example, HDT6, page 7: Temp range = 22.74 to 25.74	
1.6	Mixing	Calculated Re of diluted exhaust stream >4000?	§1065.140(c)(3)	Reference AVL setup document (document 1.6): Min Re 5.57E+04	
	Flow measurement	Does flow measurement device meet §1065.240? How is aqueous condensation addressed upstream of flow measurement? Are there any preconditioning devices?	§§1065.140(c)(4)-(6)	Described in summary of dilute sampling system (Document 1.5.pdf). Tunnel heated to 47°C, dehumidified/heated dilution air used	
	Flow compensation method	How is a nominally constant flow maintained?	§1065.140(c)(7)	Critical flow venturi with temperature and pressure control	
1.7	Dilution Air				
	How is dilution air preconditioned?	Filters, etc		HEPA filtration, dehumidifier, ultrasonic flow meter, pre-heater (further described in Document 1.5.pdf); Filter specifications found in Document 1.7	
	Dilution Air	How is it controlled? What is HC background level?	§1065.140	Bag summary on all test reports (pg 5); Report lists both sample and ambient bag concentrations	
1.8	Particulate measurement				
	Filter specifications	47mm OD? PTFE?	§1065.170(c)	Specifications on Whatman data sheet (document 1.8)	
	Dilution ratio	Primary DR at least 2:1; overall 5:1 - 7:1? Proportionality check	§1065.140(e)(2)	Listed on every test report (pg 7); Example, HDT6, primary DR = 3.33, overall DR = 6.19 (both tests)	
	Filter loading	What is the expected filter loading?	§1065.170(a)(2)	Generally <10µg (reported on all test reports); Example, HDT6 cold/hot loadings = 3.8/1.6 µg, resp	
	Sample temperature	Filter face temp 47±5°C?	§1065.140(e)(4)	Listed on every test report (pg 7); Example, HDT6, T = 46.4 to 47.6°C	
	Filter face velocity	Basis for expecting near 100 cm/s?	§1065.170(c)(1)(vii)	Listed on every test report (pg 3); Example, HDT6, V = 85.2 / 90.27 cm/s (cold/hot)	
	Is a pre-classifier used?	If so, what type?		Cyclonic seperator; see document "Preclassifier.pdf"	
	PM Sample Handling	Filter holder specifications meeting 1065? Leak check method? Filter/sample storage?	§1065.170(c)	See document 1.8.1; Vacuum side leak check performed after each test and results recorded on test report. Samples are removed from PSUs following each test and loaded into metal containers, which are then taken to the weight room for stabilization	
	Filter conditioning requirements	Min 30 minutes in env meeting §1065.190?	§1065.590(e)	Typically 60 minutes; See Document 1.8.4 for filter weighing procedure (Document 1.8.4.pdf); weigh room ambient monitor calibrations in document 1.8.4.1	
	Microbalance specifications		§1065.190(f)	Sartorious® SE2-F; See Document 1.8.2; Installed on isolated platform	
	Measurement report	Report supplied including pre/post weights, referencefilter weight, times, etc?	§1065.590	See Document 1.8.3 for sample weight report;	
2	**Gas Audit:**				

		Information & Comments	Regulations	Audit Observations	Manufacturer's Follow-up Action
2.1	Analyze EPA-supplied gases:	As lab injects gas, observe the gas flow and pressures for zero, span and audit gas. All should flow at the same pressure and flow rate. Analyzers should read EPA gases within 2%.		EPA tested 8 gas blends. All measurements were within required tolerances; Results are recorded in Document 2.1 (Main and Mini-Bench); Data format: -Row 1 = zero -Row 2 = span -Row 3 = zero -Row 4 = Bottle 1 -Row 5 = Bottle 2 (if two ranges measured)	
2.2	Engine Intake Air	How are humidity, temperature, HC, CO, Nox, etc. controlled?	§1065.125	Custom air handling system described in document 2.2 (see Document 2.2.pdf)	
2.3	Zero gas for analyzers	Check pressure & expiration date; must have ≤ 1ppmC, ≤1ppm CO; ≤400ppm CO2, ≤0.1ppm Nox.	§1065.750	Zero gas generator used; Viewed setup; Complete specifications are described in documents: -2.3.2.pdf -2.3.3.pdf -2.3.4.pdf Measured zero gas values (from gas bottle audits) in Document 2.3.1	
2.4	Nitrogen for analyzers	Check pressure & expiration date; must have ≤ 1ppmC, ≤1ppm CO; ≤400ppm CO2, ≤0.1ppm Nox	§1065.750	Bulk source; spec sheet supplied (document 2.3.2; CO impurity level)	
2.5	Lab Calibration/Span Gases:	Check pressure & expiration date; 200 psi min	§1065.750	Central bottle rooms (one toxic, one non-toxic): 6 bottles of any given mixture connected at all times; See document 2.5 for sample certificates of analysis; Observations: -C3H8+air (25 ppm): 23.98 ppm, exp 8/5/12 -CO2 (1.5%): 1.434%, exp 12/28/12 -CH4+air (10 ppm): 9.76 ppm, exp 7/10/12 -CH4+air (25 ppm): 24.00 ppm, exp 12/15/12 -NOx+N2 (20 ppm): 19.2 ppm, exp 12/28/11 -NOx+N2 (48 ppm): 47.46 ppm, exp 2/15/12 -CO+N2 (100 ppm): 95.22 ppm, exp 2/12/13	
3	**Calibration Equipment:**				
3.1	Gas Divider	Every 370 days; calib 15,30,45,60,75,90% on all ranges; rename all span gases initially & if monthly curve changes; recheck w/15-90% gas;	§1065.246; §1065.307 §1065.750	Results of 3/15/10 test on analyzer 5179 found in document 3.1; Pass	
4	**Exhaust Calibration Records:**				
4.1	HC analyzer methane response	185 Days: FID response to methane, ethanol	§1065.360	Results of 10/17/09 test on analyzer HTHC_1 - Horiba FID Model FIA 236 (device not listed in site inventory; wil be added per 4/8 email from D Pitschel); Pass	
4.2	HC analyzer linearity	35 Days: calibrate each range w/gas divider (±2% each point)	§1065.307	Results of 3/13/10 test on analyzer HTHC_1 (device in bench: GM_NGSBAG - PN 170223) found in document 4.1.2. Two ranges checked. Pass	
4.3	CH_4 analyzer linearity	35 Days: calibrate each range w/gas divider (±2% each point)	§1065.307	Results of 3/12/10 test on analyzer CH4_1 (device in bench: GM_NGSBAG) found in document 4.1.3; Pass	
4.4	CO analyzer linearity	35 Day: calibrate each range w/gas divider (±2% each point)	§1065.307	Results of 3/12-13/10 test on analyzer COL_1 ((ID: PN013709) device in bench: GM_NGSBAG) found in document 4.1.4, Two ranges checked. Pass	
4.5	CO analyzer interference	After installation and major maintenance: water vapor & CO_2 interference (<1% or 3ppm);	§1065.355	Results of 3/25/09 test on analyzer COL_1 ((ID: PN013709) device in bench: GM_NGSBAG) found in doc 4.1.5, Pass	
4.6	CO_2 analyzer linearity	35 Day: calibrate each range w/gas divider (±2% each point)	§1065.307	Results of 3/12-13/10 test on analyzer CO2_1 ((ID: PN013712) device in bench: GM_NGSBAG) found in doc 4.1.6 for 2 ranges, Pass	
4.7	CO_2 analyzer interference	After installation and major maintenance: water vapor interference (<1% or 3ppm);	§1065.359	Results of 3/25/09 test on analyzer CO2_1 (ID: PN013712) found in doc 4.1.7, repeated on 4/8/10 (doc 4.1.7b), Pass	
4.8	NOx analyzer linearity	35 Day: calibrate each range w/gas divider (±2% each point)	§1065.307	Results of 3/11-12/10 test on analyzer NOX_1 ((ID: PN018106) device in bench: GM_NGSBAG) found in doc 4.1.8 for 2 ranges, Pass	
4.9	NOx analyzer conversion verification	35 Day; Efficiency > 95%	§1065.378	Results of 3/10/10 test on analyzer NOX_1 ((ID: PN018106) device in bench: GM_NGSBAG) found in doc 4.1.9, Pass	
4.9.1	O2 analyzer linearity	35 Day: calibrate each range w/gas divider (±2% each point)	§1065.307	Results of 3/11/10 test on analyzer O2_2 ((SN: 65369) device in bench: GM_NGS) found in doc 4.1.9.1, Pass	
4.10	CVS propane injections	35 Day: one range (e.g. 100ppm) all analyzers, all commonly used venturis (may rotate venturis thru successive weeks); (+2%); Calibration report available? CFO or Mass balance calibration records?	§1065.341	Real-time fast propane injections recorded on every test report (ref Pg 8 of HDT6 report); See also document 4.10 for full C3H8 injection check performed on 3/16/10 (for both tunnel and SDS); Pass	
4.11	Flow meters				
	Fuel Flow (if used)	Off-site cal or through carbon/oxygen balance	§1065.320	N/A	
	Intake Flow (if used)	Off-site cal or LFE, subsonic venturi, or ultrasonic flow meter	§1065.325	N/A	
	Exhaust Flow (if used)	Off-site cal, subsonic venturi, or ultrasonic flow meter	§1065.330	N/A	
	CVS Flow	On site reference flow meter or calibration certificate	§1065.340	Critical flow venturis; calibration certificates in document 1.6	
4.12	Dynamometer verifications	Annually: In-line torque sensor	§1065.310	Results of 3/10/10 test on sensor PN022346 found in document 4.12, Pass	

		Information & Comments	Regulations	Audit Observations	Manufacturer's Follow-up Action
4.13	Ambient monitors	ambient temperature, humidity	§1065.315	Calibration records found in document 4.13 (all pass): Exh backpressure; 10/29/09 Ambient pressure; 9/15/09 Ambinet temp; 3/10/10 Combustion air temp; 9/15/09 Combustion air press; 9/15/09 Rel Humidity; 9/15/09 SCR Outlet, 9/15/09	
4.14	Maintenance Records:	Must calibrate analyzers after maintenance. Recommend keeping a separate maintenance log.	§1065.503	On-line database of instrument maintenance; Shows date of maintenance request, requestor, services performed (& date), and all other relevant information pertaining to maintenance. Equipment in D102 was fairly new at the time of audit, so there was not an extensive history of maintenance.	
5	**Engine Setup & Test Observations:**				
5.1	Engine serial number	POGHG766AJ, Code 1 (cert engine)		All documentation reflected correct number, however stamping on engine had an alternate suffix (AA instead of AJ). Upon questioning, GM stated that the unique identifier for pre-production engines is the 3 digit number (766) and that different suffixes may exist in different databases (all relating to the same engine).	
5.2	Service accumulation			158 hrs of service accumulated by the end of the audit	
	Method/duty cycle			Complete records supplied showing all activities relating to the running of this engine from initial start-up in Nov 2009. Refer to Document 5.2.pdf	
	Maintenance	Unscheduled or scheduled?			
5.3	Fuel supply temperature/pressure	Representative of in-use operation?	§1065.120(c)	Recorded on each test report & conditioned as necessary to reflect in-use temperatures. Pressure deviates slightly from production in that a slight positive pressure is supplied to HP fuel pump. In production, this pump draws from the tank so a slight vaccuum exists, which is impractical to replicate in test cell. GM claims no impact to engine performance	
5.4	Oil/engine block cooling provisions	Are engine oil and block temperatures representative of in-use conditions?	§1065.122(a)	No special provisions are made for cooling (i.e. no fans or external cooling)	
5.5	Engine intake air temperature	25±5°C?	§1065.125	Maintained between 20 and 30°C and reported on every test report	
5.6	Intake system	Is the intake system production representative?	§1065.125(d)	Mostly production representative; Some slight modifications to snorkel/filter box assembly for T/C, pressure transducers, etc. Refer to test cell photographs	
5.7	Charge air cooler	Is the CAC production representative? If not does CAC simulator meet §1065.125(e)?	§1065.125(e)	Non-production representative. Test cell uses an air-water vs air-air in the vehicle. Slightly less capacity & effectiveness than production to give worst-case effect; Refer to test cell photos	
5.8	Exhaust system	Representative of production? Are A/T devices located in production representative locations?	§1065.130	Production exhaust system up through the DPF/SCR system (including production DEF tank and dosing system). After DPF/SCR, a restriction valve was used to tune overall restriction to production representative values (basically accounting for muffler restriction).	
5.9	Laboratory tubing	Minimized length between exit of in-use exhaust system or last A/T device and first point of dilution?	§1065.130(c)	Approximately 6' uninsulated pipe length after last A/T device, followed by approximately 10-15' of insulated pipe to tunnel. Reference test cell photographs	
5.10	Exhaust restriction	Typical of in-use operation?	§1065.130(h)	See 5.8. Range of exhaust restriction values are recorded on all test reports and validated at rated conditions following testing	
5.11	Crankcase emissions	Self-contained or routed to dilution tunnel?	§1065.130(i)	Completely self-contained using production representative CCV system. System described in Document 5.11.pdf	
5.12	Simulated inputs	Are any simulated engine loads applied during testing?	§1065.110	CITT = 88-89 NM (only used with A/T)	
	Accessories	Are all acessories present? If not, how are loads simulated?		Alternator present and active (all electrical loads of the engine are supported by the alternator). Testing begins with batteries at full charge (maintained by battery chargers). All other accessories were determine to be less than 0.5% power and are therefore ignored.	
	Vehicle speed input	Is a simulated vehicle speed supplied?		Dyno-unique calibration removes requirement for VSS (amongst other items). Full list of changed parameters supplied by GM; See Document: "List of Cal Changes for Dyno Testing.pdf"	
	Other	Are other special inputs required to simulate vehicle functionality?		See above	
5.13	Ambient conditions	Approximate temperature, pressure, and RH during testing		All ambient conditions are recorded on test reports. Temp range: 20-30, pressure range: 80-103.325 kPa.	

		Information & Comments	Regulations	Audit Observations	Manufacturer's Follow-up Action
5.14	Regeneration identification	How are regeneration events identified during testing?		Test cell interface has several monitors, each showing different parameters from engine operation, aftertreatment operation, and test cell operation (ambient conditions, emissions sampling, test progress). On the aftertreatment screen is a field which identifies regeneration and how long until regen completes (if active)	
5.15	Curb idle speed & torque?			600 RPM & 88-89 Nm. Idle speed increased if regeneration occuring. Both parameters are listed on test report	
5.16	Maximum test speed	Observed or declared?		3100 - Declared. Map supplied (agrees with calculated value)	
5.17	A, B, C Speeds			1947, 2394, 2840 RPM (calculated from map); 1939, 2399, & 2840 RPM (reported)	
6	**Test Validation**				
6.1	Transient cycle trace	Review a speed-load trace	§1065.514	Speed/Load trace could be viewed as test was running. Also, speed and torque traces were supplied from Tests HDT4 and HDT5, which show command vs feedback signals (refer to folder: D102 Regression Analysis)	
6.2	Cycle validation report	Does test meet cycle regression statistics? Is report available?	§1065.514	Each test report has a page dedicated to cycle regression analysis. HDT4, HDT6, & RMC5 all passed regression checks. HDT5 did not pass due to regeneration occuring. This resulted in the idle speed increasing from 600 to 800 RPM. Even with idle points manually removed, cycle still failed validation	
6.3	Analyzer range, drift validation, and drift correction	±4% uncorrected vs corrected	§1065.550	Each test report has a page dedicated to analyzer calibrations (post test). If deficiencies are found, test in invalidated. Fast propane check and hang-up checks are also performed and documented in test report	
6.4	Proportional sampling validation	SEE <3.5% of mean sample flow rate or each flow rate within 2.5% of mean or target flow rate. Is report available?	§1065.545	All dilution ratios recorded and checked on test report	
7	**Calculations**				
7.1	Emission Calculations:	Review calculations. Calcs should not use negative emission (bag) values.	§1055 subpart G	Addressed in supplemental document (Document 7.0.pdf). All calculations handled by AVL software	
7.2	Brake specific calculation method	Total mass divided by total work?	§1065.650	Addressed in supplemental document (Document 7.0.pdf). All calculations handled by AVL software	
7.3	NOx Correction Factor (K_H)	$K_H=1/(9.953 \times X_{H2O} + 0.832)$?	§1065.670	Addressed in supplemental document (Document 7.0.pdf). All calculations handled by AVL software	
8	**Test Results**				
8.1	QA/QC Documentation	How are tests reviewed for accuracy, completeness?		Automated report generation showing ranges, checks, etc (AVL PUMA)	
8.2	Torque/power	331 HP (247 kW) @3100 RPM, 687 ft-lb (931 NM) @1600 RPM		262.7 kW (at 3100 RPM), 951.8 NM (at 1650 RPM). Reference document Power Map.pdf	
8.3	Maximum test speed	Is the maximum test speed calculated correctly?	§1065.610	EPA calculated value matches declared value	
8.4	Speed vs torque map	Has report been supplied including a speed vs torque map?	§1065.510	Yes, reference document Power Map.pdf	
8.5	Test Report	Has a test report been supplied including emission results for each test cycle/test interval?		Following test reports have been supplied: -HDT4.pdf - Cold/hot FTP from 3/23/10 -HDT5.pdf - Cold/hot FTP from 3/24/10 -HDT6.pdf - Cold/hot FTP from 3/25/10 -RMC5.pdf - RMC from 3/24/10 -NTE Points.xls from 3/24/10	
8.6	Final calculated emissions	Do emissions results indicated compliance with standards (with DFs and tRAFs applied)? [EPA calculated]		Reference EPA document "DMAX Lug and NTE.xls" -NTE deficiency for SCR dosing adaptation; referred to cert group in DC -FTP & RMC results: Pass	
9	**Fuel Analysis**	monthly. Obtain copy of lab fuel analysis; Take fuel samples of test fuel.	§1065.703	Fuel analysis report supplied by GM (document:GM Fuel Analysis.pdf), showing passing results for Cert Diesel Fuel. 1L fuel sample drawn for analysis at NVFEL	
10	**DEF Analysis**				
10.1	AUS32	Commerical brand meeting ISO-22241?		Terra-CAIR brand. Lot number recorded on each test report	
10.2	Urea concentration	31.8 < Urea Concentration < 33.2%	ISO22241-2 Annex C	Daily refractometer readings taken and recorded on test reports. Witnessed reading of 32.1% urea by volume on 3/25/10	
10.3	Sample drawn	1L sample taken for full chemical analysis?		Sample taken and sent to lab for analysis. Results show compliance with ISO-22241 (ref. Document 10.3)	
11	**Other/General Observations**				
	DEF Dosing			Instantaneous DEF dosing rate was displayed and ranged in value from 0 to approximately 300 mg/s.	

		Information & Comments	Regulations	Audit Observations	Manufacturer's Follow-up Action
	NTE Point Evaluation			Each point was recorded in the following manner: -Engine speed/load stabilized -30 second data samples were taken (avg and max/min values recorded) -10 sample points were recorded for all points except the two in the RTZ -2 RTZ test points were sampled for 10 minutes (instead of 5 minutes)	